C L A I M S

1. An expandable bladder for tyre manufacturing apparatuses, comprising:
- at least one first layer (8) of a first elastomer material,
- and a second layer (9) of a second elastomer material different from said first elastomer material;
- wherein said second layer (9) is at a position radially external to said first layer (8);
- wherein said first and second layers (8, 9) have an undulated interface profile (10);
- wherein said interface profile (10) defines mechanical-engagement elements (10a) between the first and second elastomer materials.

2. A bladder as claimed in claim 1, having a toroidal conformation.

3. A bladder as claimed in claim 1 or 2, having at least one circumferential edge carrying at least one circumferential anchoring tailpiece (1a).

4. A bladder as claimed in claim 1 or 2, wherein the interface profile (10) has a wave height (H) and a wave pitch (P), wherein the wave height (H) is higher than or as high as one tenth of the wave pitch (P).

5. A bladder as claimed in claim 4, wherein the wave height (H) is higher than half the wave pitch (P).

6. A bladder as claimed in claim 1 or 2, wherein the undulated profile (10) has a plurality of waves with an inclined extension relative to a direction (Q) normal to a median extension line (L) of the undulated profile

itself.

7. A bladder as claimed in claim 6, wherein each wave has an inclination angle (α) between a bisecting line (K) of a vertex of said wave and said direction (Q) normal to the median line (L), included between about 45°and about 88°.

8. A bladder as claimed in claim 7, wherein said inclination angle (α) is included between about 60° and about 85°.

9. A bladder as claimed in claim 1 or 2, wherein said mechanical-engagement elements (10a) have portions (10b) of mutual undercut constraint.

10. A bladder as claimed in claim 1 or 2, wherein at a position radially internal to said first layer (8), a third layer (11) of elastomer material cross-linked with at least said first elastomer material is disposed.

11 A bladder as claimed in claim 1 or 2, wherein at a position radially external to said second layer (9), a fourth layer (12) of elastomer material cross-linked with at least one of said first and second elastomer materials is disposed.

12. A bladder as claimed in claim 1 or 2, wherein said second layer (9) extends along at least one surface portion of the first layer (8).

13. A bladder as claimed in claim 12, wherein said at least one surface portion of the first layer (8) is close to a circumferential edge of the bladder (1).

14. A method of manufacturing an expandable bladder for tyre manufacturing apparatuses, comprising the steps of:

- preparing at least one first elongated element (13) including a first raw elastomer material and at least one second elongated element (14) including a second raw elastomer material having a different composition from that of the first elastomer material;
- laying said first elongated element (13) on a forming support (18), in the form of coils wound up around a geometric axis (X) of said forming support (18) so as to form a first layer (8) of said first elastomer material;
- laying said second elongated element (14) on the forming support (18), in the form of coils wound up around the geometric axis (X) of said forming support (18) so as to form a second layer (9) of said second elastomer material at a radially external position to said first layer (8);
- said first and second layers (8, 9) having an undulated interface profile (10), wherein said interface profile (10) defines mechanical-engagement elements (10a) between the first and second elastomer materials;
- curing said bladder.

15. A method as claimed in claim 14, wherein said interface profile (10) has a wave height (H) and a wave pitch (P) in which the wave height (H) is at least as high as one tenth of the wave pitch (P).

16. A method as claimed in claim 15, wherein the wave height (H) is higher than half the wave pitch (P).

17. A method as claimed in claim 15, wherein the

undulated profile (10) has a plurality of waves with an inclined extension relative to a direction (Q) normal to a median extension line (L) of the undulated profile itself.

18. A method as claimed in claim 17, wherein each wave has an inclination angle (α) between a bisecting line (K) of a vertex of said wave and a direction (Q) normal to the median line (L), included between about 45°and about 88°.

19. A bladder as claimed in claim 18, wherein said inclination angle (α) is included between about 60° and about 85°.

20. A method as claimed in claim 14, wherein said mechanical-engagement elements (10) have portions (10b) of mutual undercut constraint.

21. A method as claimed in claim 14, wherein at least one of said first and second elongated elements (13, 14) has a flattened cross-section conformation.

22. A method as claimed in claim 14, wherein at least one of said first and second elongated elements (13, 14) has a substantially triangular cross-section conformation.

23. A method as claimed in claim 14, wherein at least one of said first and second elongated elements (13, 14) has a substantially trapezoidal cross-section conformation.

24. A method as claimed in claim 14, further comprising a step of mutually coupling the first and second

elongated elements (13, 14) in the longitudinal extension of same for preparing a continuous strip-like element (20) that is wound around the geometric axis (X) of said forming support (18) during the laying step.

25. A method as claimed in claim 24, wherein the coupling step is carried out before the laying steps.

26. A method as claimed in claim 24, wherein preparation of the continuous strip-like element (20) comprises the steps of:
- feeding the first elongated element (13) through a first feeding member (15);
- feeding the second elongated element (14) through a second feeding member (16) simultaneously with feeding of the first elongated element (13);
- guiding the first and second elongated elements (13, 14) in converging direction with respect to each other, towards a point of mutual coupling.

27. A method as claimed in claim 26, wherein feeding of the first and second elongated elements (13, 14) takes place by extrusion through a first and a second extruders (15, 16) respectively, which are part of said first and second feeding members.

28. A method as claimed in claim 24, wherein the continuous strip-like element (20) is made by co-extrusion of the first and second elongated elements (13, 14) through the same extruder (26).

29. A method as claimed in claim 24, wherein the coupling step is carried out simultaneously with winding of the strip-like element (20) on the forming

support (18), at a point of mutual coupling between the elongated elements (13, 14) located on the forming support (18).

30. A method as claimed in claim 24, wherein the coupling step is carried out simultaneously with winding of the strip-like element (20) on the forming support (18), at a point of mutual coupling between the elongated elements (13, 14), located upstream of the forming support (18).

31. A method as claimed in claim 14, wherein the first and second elongated elements (13, 14) are simultaneously laid on the forming support (18) at points (A, B) mutually spaced apart in a circumferential direction.

32. A method as claimed in claim 24, wherein following the coupling step, each of said elongated elements (13, 14) has a base portion (21, 22) integral with a base portion of the other elongated element, and at least one of said elongated elements (13, 14) has an apex (23, 24) transversely projecting from the base portion (21, 22) with respect to a mutual-alignment direction (D) of the base portions (21, 22).

33. A method as claimed in claim 32, wherein the first and second elongated elements (13, 14) are coupled at mutually offset positions transversely of a direction (D) of mutual alignment of the base portions (21, 22), so that each elongated element (13, 14) has said apex (23, 24) projecting in the opposite direction with respect to the apex of the other elongated element.

34. A method as claimed in claim 32 or 33, wherein the

apex (23, 24) of an elongated element (13, 14) is turned up against a base portion (21, 22) of the other elongated element.

35. A method as claimed in claim 14, wherein laying of each of said first and second elongated elements (13, 14) comprises the steps of:
- feeding the elongated element (13, 14) from a feeding member (15, 16, 17) disposed close to the forming support (18) to apply said elongated element (13, 14) onto the support itself;
- giving the forming support (18) a rotatory motion for circumferential distribution around the geometric rotation axis (X), so that the elongated element (13, 14) is circumferentially distributed on the forming support (18);
- carrying out controlled relative transverse-distribution displacements between the forming support (18) and the feeding member (15, 16, 17) to form said coils.

36. A method as claimed in claim 14, further comprising the step of applying at least one third layer (11), radially internal to said first layer (8), onto the forming support (18), which third layer (11) is of an elastomer material cross-linkable with said first elastomer material.

37. A method as claimed in claim 14, further comprising the step of applying a fourth layer (12) to said second layer (9) at a radially external position, said fourth layer (12) being of an elastomer material cross-linkable with at least said second elastomer material.

38. A method as claimed in claim 14, wherein during the

bladder (1)-curing step at least one step of injecting elastomer material into said mould is carried out, to form at least one additional coating layer on the bladder (1).

39. A process for manufacturing tyres comprising the steps of:

- forming on a drum (3), a carcass structure (4) comprising at least one carcass ply (5) having opposite end flaps (5a) in engagement with respective annular reinforcing structures (6);
- inflating at least one expandable bladder (1) in the vicinity of each of said annular reinforcing structures (6);
- shaping the carcass structure (4) into a toroidal conformation to apply an annular belt structure (28) and a tread band (29) to the carcass ply (5);
- curing the tyre;

wherein each of said expandable bladders (1) comprises:

- at least one first layer (8) of a first elastomer material and one second layer (9) of a second elastomer material different from said first elastomer material;
- wherein said second layer (9) is at a radially external position to said first layer (8);
- wherein said first and second layers (8, 9) have an undulated interface profile (10);
- wherein said interface profile (10) defines mechanical-engagement elements (10a) between the first and second elastomer materials.

40. A process for manufacturing tyres as claimed in claim 39, wherein associated with the carcass structure (4) are sidewalls (7) extending each away from one of the annular reinforcing structures (6), wherein the step of inflating said expandable bladders (1) is at

least partly carried out after the shaping step for applying each sidewall against the carcass ply.

41. A process as claimed in claim 39, comprising the step of:
- inflating at least one expandable bladder (1) in the vicinity of each of the axially opposite edges of said annular belt structure (28) to apply them against the carcass ply (5).

42. A process of manufacturing tyres as claimed in one or more of claims 39 to 41, wherein each of said expandable bladders (1) is defined as claimed in anyone of claims 2 to 13.

43. A manufacturing apparatus for tyres of vehicle wheels, comprising:
- devices designed to form a carcass structure (4) on a drum (3), which carcass structure comprises at least one carcass ply (5) having opposite end flaps (5a) in engagement with respective annular reinforcing structures (6);
- at least one pair of expandable bladders (1) operatively associated with said drum (3), each of said expandable bladders (1) being inflatable in the vicinity of one of said annular reinforcing structures (6);
- devices (30) for positioning a belt structure (28) around said carcass structure (4);
- devices to shape the carcass structure (4) into a toroidal conformation for applying an annular belt structure (28) to the carcass ply (5);
wherein each of said expandable bladders (1) comprises:
- at least one first layer (8) of a first elastomer material and one second layer (9) of a second elastomer

material different from said first elastomer material;
- wherein said second layer (9) is at a position radially external to said first layer (8);
- wherein said first and second layers (8, 9) have an undulated interface profile (10);
- wherein said interface profile (10) defines mechanical-engagement elements (10a) between the first and second elastomer materials.

44. An apparatus as claimed in claim 43, wherein said devices designed to form the carcass structure comprises members for applying a pair of sidewalls (7) extending each on one of said expandable bladders in a deflated condition, so that said sidewalls (7) are applied against the carcass ply (5) following inflation of said expandable bladders (1).

45. An apparatus as claimed in claim 43, comprising:
- at least one pair of expandable bladders (1) operatively associated with said positioning devices (30) of the belt structure (28), each of said expandable bladders (1) being inflatable in the vicinity of one of the axially opposite edges of the belt structure (28) to cause application of the latter against the carcass ply (5) shaped into a toroidal conformation.

46. An apparatus as claimed in claim 43, wherein said drum (3) is a building drum.

47. An apparatus as claimed in claim 43 or 46, wherein said drum (3) is a shaping drum.

48. A manufacturing apparatus for tyres of vehicle wheels as claimed in one or more of claims 43 to 47,

wherein said expandable bladder (1) is defined as claimed in anyone of claims 2 to 13.